DR. NATHANIEL HAYCROFT has reprinted his inaugural address, delivered before the Leicester Literary and Philosophical Society, on the Limits of Scientific Inquiry; and we find also the abstract of a paper read at the last meeting of the Natural Science Section of the Sheffield Philosophical Society by the President, Dr. Hime, on Phenomena and Forces, both rather extensive subjects for an hour's discourse.

THE following is from the *Journal of the Society of Telegraph Engineers*:—"Thanks to the noble exertions of the illustrious president of the Italian Geographical Society, the idea of an Arctic expedition under the Italian flag is gradually working its way into their minds. Funds have been offered, and the prospect is brightening that the old voyage of the *Zeni*, though the first, will not be the last of the Italian Arctic expeditions." The same journal says that Signor Guido Cora announces his intention of editing an Italian geographical periodical, to be entitled *Kosmos*, the first number of which is to appear on January 1, 1873.

THE following is from the *School Board Chronicle*:—"New York has 101,883 scholars to rather over a million of inhabitants; these children receive their instruction from 2,765 masters (*i.e.*, one teacher to every thirty-six pupils); the educational budget amounts to very nearly 700,000*l.*, or 7*l.* for each child. In England, in one year, 35,999 men and 49,522 women were found unable to sign the marriage register."

NUMEROUS seals, very rare in these waters, are making their appearance at the mouth of Holy Loch and in Loch Long, in the Frith of Clyde.

WE learn from the *American Agriculturalist* that it has been finally decided to locate the arboretum, for which a large bequest was made to the Harvard University by Mr. Arnold, of New Bedford, on a farm, about ten miles south of Boston, where the School of Agriculture already exists. The details of the work are to be under the immediate control of Prof. Sargent, who is eminently well qualified for it. He proposes to lay out the ground (137 acres of well-diversified land) as a natural park, with drives and walks tastefully arranged, and leading from one family to another, in scientific order, of all the trees and shrubs hardy in that climate.

A "CENTENNIAL Commission" has been appointed by the American Congress to mature a scheme for the celebration of the nation's hundredth anniversary in 1876, by holding an International Exposition in Philadelphia, which shall be "the grandest the world has ever seen." The sum required to conduct it properly is estimated at $10,000,000, and each State is called upon to subscribe its share of the amount as definitely fixed by the Commission. At a recent public meeting in Philadelphia $100,000 worth of stock was taken in fifteen minutes.

THE American Palestine Exploration Society, of which we have already made mention in our columns, is about sending off an expedition for the purpose of carrying out the objects of that body. According to the *Independent*, it is to be under the direction of Lieut. E. Steever, U.S.A., who will have special charge of the topographical survey, and of the preparation of a reliable map. He will be accompanied by Prof. John A. Payne, late of Robert College, Constantinople, who will superintend the archæological department, and make what collections he can in natural history and geology; but, being himself especially a botanist, he will devote his principal attention to that branch. Mr. Van Dyke and other gentlemen will probably accompany the party to the field, and among them will be an artist of considerable reputation. This labour is one, of course, that will require some time for its completion; and, according to the *Independent*, at least six years will be necessary to accomplish its object thoroughly, even allowing for the assistance of a British society (organised for a similar purpose) in doing its share of the work.

THE DIOSMOTIC PROPERTIES OF COLLOIDS*

DUTROCHET, in his researches on osmose, examined the properties of certain organic non-crystallisable substances (later named colloids by Graham).

Comparing the colloids gelatin, gum-arabic, and albumen (from hens' eggs) with cane sugar, he thus expressed numerically the endosmotic power of these substances:—Gelatin, 3; gum-arabic, 5·17; sugar, 11; albumen, 12. Thus the endosmotic force attributed to the colloids was considerable, in the case of albumen exceeding that of sugar.

These results must, however, be considered in great measure fallacious, as, while the specific gravities of the solutions were equal, (1·01) their degrees of concentration were very different. The solutions of gelatin and albumen contained 4·1 per cent. of these substances, while the sugar solution scarcely contained 2·5 per cent. of sugar. On this ground the sugar must be ranked above the colloids.

There is another circumstance to be considered. Dutrochet used the colloids in their natural state (common gum-arabic and albumen direct from the egg), and in this form they contain over 3 per cent. of mineral substances, chiefly salts of lime and potash. Since Graham pointed out the great difference between crystalloids and colloids, as regards diffusion in water and passage through a membrane, it was to be expected that the presence of crystalloids in the colloidal substance would considerably mask the diosmotic properties of the latter. In the writer's experiments he employed colloids freed from mineral substances, comparing their diosmotic properties with those of the same substances in the natural state. Contrary to the generally received opinion that these substances have a high endosmotic power, he found that this is not the case, though certain variations are met with, which will presently be explained.

Solutions of pure colloids showed, when of moderate concentration, a very weak endosmose. The properties of the membrane, however, distinctly affect the results. Animal bladder, parchment, and artificial cellulose, are very near one another in this respect. With the first two the concentration of an albumen or arabin solution might be raised to about 10 per cent. without any perceptible increase of volume in the solution, at the expense of the pure water. Tannin gave a slight endosmose; a 10 per cent. solution in 24 hours received 1·0 cc. water (the membrane being parchment). The degree of concentration now given may be considered about the limit within which, for these substances, and with the membranes named, no addition of water takes place. With the artificial cellulose, the limit seems to be somewhat lower, for a 9 per cent. arabin solution gave (with it) a perceptible, though very weak endosmose (about 0·45 c c) in 24 hours, and a tannin solution 7 per cent. increased in volume 0·8 cc. in the same time.

On comparing with colloids in the impure state, it was found that while a 10 per cent. arabin solution received hardly any water through the parchment, (about 0·5 cc.), an equally concentrated solution of common gum-arabic increased in volume, in the same circumstances, about 2·55 cc.

When a pyroxilin membrane was used with the pure colloids, the endosmotic action was considerably greater than that which took place in the other membranes. Thus with pyroxilin a 10 per cent. solution of albumen increased 9·0 cc. in volume, and an equally concentrated arabin solution 14·0 cc.; while, in the same time, when the membrane was animal bladder or parchment, the endosmose was hardly perceptible (0·5 cc.). This shows that the weak endosmotic action of colloids, when particular membranes are used, is not to be attributed to their weak attraction for water, but rather to the properties of the membrane. And in the above case it appears that the different behaviour of the membranes corresponds to their different absorptivity for water. Especially does this appear from the fact that a very different endosmose takes place with one and the same membrane, according as it is employed as pyroxilin, or after its reduction as cellulose (by a process described in a previous part of the paper). Thus a 7 per cent. arabin solution received, through a pyroxilin membrane, 5·3 cc. water; when the membrane was reduced, an equally concentrated solution showed no endosmose, and a 9 per cent. solution of the same substance only received about 0·45 cc. water.

For substances largely soluble in water, the attraction of their particles to water may have wide limits of variation, according

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* Abstract of part of a paper in "Poggendorff's Annalen," by J. Baranetzky.

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to the measure of concentration. Those substances, on the other hand, which can only receive limited quantities of water, as *e.g.* cellulose, are, when brought into contact with water, soon saturated, and have thereafter an unvarying attraction for water. When, therefore, an arabin or albumen solution of certain concentration receives no water through the animal bladder or parchment, this only shows that with the concentration given, these colloids have less attraction for water than the membranes have. If, however, the concentration is raised above a certain limit, the attraction of the membrane for water is overcome, and endosmose occurs. This limit, the same membrane being used for different colloids, must evidently depend on the attraction of these for water. My experiments show that in equally concentrated solutions tannin gives the greatest endosmotic action; then follows arabin, and next albumen, an order agreeing with the stability of these substances in their aqueous solutions, which may in general be taken as a measure of their affinity for water. From membranes like pyroxilin, in which the water is held with little force, it can be withdrawn by weak colloid solutions; hence a much greater endosmotic effect is seen in this case.

In further support of the explanation now given, we have the fact that with membranous substances chemically the same the colloid solutions show greater endosmotic force the less dense the membrane is, *i.e.* the wider its water-filled interstices are. Indeed the attraction of water to the substance of the membrane must diminsh greatly with the distance.

The particles of water in the central parts of the interstices will be less attracted the wider these interstices. This may be illustrated by using two pyroxilin membranes of different densities. Thus, employing a 7 per cent. arabin solution, it was found that in 24 hours 5·3 cc. water passed through the denser membrane, whereas 9·5 cc. passed through the other. Similarly with two pieces of parchment from different manufacturers, a 10 per cent. arabin solution gave in one case 0·5 cc., and the other 1·6 cc. endosmose, and after expanding in all directions, the more compact of the two, an equally concentrated arabin solution, gave, with it, 3·5 cc. endosmose.

If we consider the case of the impure colloids, it is not easy to see in what way the presence of so small a quantity of crystalloid substance increases the endosmotic action so greatly; for the same quantity of crystalloid, taken by itself, does not give the weakest perceptible endosmose. In the converse case, addition of a small quantity of colloid to a crystalloid solution, the endosmose of the latter is increased also.

Fick observed that endosmotic equivalents must be higher the more mobile the particles of the salt solution employed. The presence of colloids in the solutions makes the latter denser; when, however, a crystalline substance is dissolved in a dense fluid, its particles must be less mobile than in solution with pure water; and this is the most probable explanation of the action of colloids in exalting the endosmotic force of crystalloid substances.

It is, however, found that when a colloid solution is submitted to diosmose of water containing even a small quantity of a crystalline salt, instead of to pure water, the endosmose of the colloid is considerably diminished.

The action of the crystalloid in this case cannot be attributed to an endosmotic current originated by it; none of the salt solutions that were employed showed, in direct experiment with water, the slightest increase of volume at the cost of the water. The phenomenon is one requiring further experiment in order to arrive at its explanation. A. B. M.

SCIENTIFIC SERIALS

Poggendorff's Annalen der Physik und Chemie, No. 10, 1872.—This number commences with a paper by Dr. Herwig on the expansion relations of superheated vapours. In his experiments he used a U-tube, one limb of which contained the vapour and the other dry air, these being separated by a little mercury, and the instrument being heated in a bath. The general result arrived at is that, at certain low pressures, with constant volume, superheated vapour has a smaller coefficient of expansion than that of perfect gases (viz. 0·003663). The numerical results for sulphide of carbon, chloroform, and alcohol, are tabulated.—J. Baranetzky communicates a long and interesting paper of researches in diosmosis.* Sketching the history of the subject, he points out several defects in previous investigations. Nearly all the experimenters from Vierodt's time have sought to determine the endosmotic equivalents of salts, and the results are very discordant. The diosmotic properties of colloids have been imperfectly studied and misconceived. The membranes employed have mostly been animal, and the influence of the nature of the membrane is a question which, M. Baranetsky thinks, has hardly been touched. Having directed his experiments to some of these points, he shows the influence of various kinds of membrane (parchment, bladder, artificial cellulose, pyroxilin), and various thicknesses of membrane on the endosmose of various salts. As to the colloids, he found that, when of moderate concentration (say 10 p. c.) *and freed from mineral substances*, they showed little or no endosmose; and for the same degree of concentration, pyroxilin and cellulose gave more endosmose than animal membranes. The writer further discusses the influence of adhesion, and concludes by applying his observations to animal and plant life.—G. Vom Rath gives his concluding mineralogical paper, treating chiefly of the chemical composition of some Vesuvian products; and this is followed by an account of some studies in micro-mineralogy (last of a series also) by Dr. V. Lasaulx.—In a note by H. F. Weber, on the specific heat of carbon. the discrepancy of various observations is attributed to the fact that the specific heat (in this case) varies with the temperature, being tripled, in the case of the diamond, between 0° and 200°.

The *Lens* for July 1872, contains—"Algæ Rhodiaceæ, a list of Rhode Island Algæ," by Stephen T. Olney, including the Desmidiaceæ and Diatomaceæ.—"The Cell," by J. N. Danforth, M.D., commences an examination of the theories of cell development.—"The Flora of Chicago and its vicinity," by H. H. Babcock, is continued from the previous numbers.—"The Markings of the Test Podura Scale," by F. W. S. Arnold, M.D., accompanied by an Albert-type plate from negatives produced by the author. It contributes very little to the controversy. "A Conspectus of the Families and Genera of the Diatomaceæ," by Prof. H. L. Smith, is continued, with an "Index to Synonym Register."—"Microscopical Memoranda for the use of Practitioners of Medicine," by Dr. J. J. Woodward, is also continued from the previous number.—"Fungi in Cows' Milk," by Prof. James Law. In this case the fungi are presumed to have originated from impure water supplied to the herd.—"Hepatica," by H. H. Babcock, and "Puccinea on Paper," by Thomas Taylor, are short papers; as are also those by F. W. S. Arnold, on "Hæmatoxylin as a staining material for animal tissues;" and A. Prazmowski, on "Draw-tubes *v.* deep eyepieces."

In No. 1 of the *Proceedings of the Swedish Academy of Sciences* for the present year (Ofversigt af Kongl, Vetenskaps Akademiens Förhandlingar, Arg. 29, No. 1) M. A. E. Förnebohm gives a geognostic section of the central chain of Scandinavia between Ostersund on the east and Levanger on the west. The section includes primitive Cambrian and Silurian rocks, and the author remarks that the most striking point in it is, that fossiliferous Silurian rocks are covered in the Areskuta by two great schistose non-fossiliferous formations resembling the typical rocks of what he calls the primitive formation (gneiss, hornblende, schists, &c.). A short summary in French is appended to this paper, which is illustrated with woodcuts and a folding plate.—M. E. Edlund communicates a continuation of his attempt to explain the phenomena of electricity by means of the luminiferous ether.—From M. O. J. Fahrœus we have a long series of Latin descriptions of Caffrarian *Longicorn Coleoptera* collected between the years 1838 and 1845 by J. A. Wahlberg. The species here described (58 in number) belong to the divisions *Prionidæ* and *Cerambycidæ*, and include the types of several new genera.—M. H. Gyldén gives formulæ and tables for the calculation of the distance at which lighthouses may be visible.—M. Hjalmar Stolpe communicates the results of natural history and archæological investigations in Björkö and Mälaren.—The tendency of the trichomata of plants to changes of form is the subject of a paper by M. P. G. E. Theorin, in which the author describes and figures certain forms of those organs occurring in the common yellow water-lily.—M. Gustaf Eisen notices some Arctic oligochætous annelides, including three species of *Lumbricus* and a *Rhynchelmis* from Newfoundland, and a *Lumbriculus* from Greenland. *Lumbricus puter* (Hoffm.) is briefly described, and *Enchytrœus Pagenstecheri* (Ratzel) from Greenland, in more detail, for comparison with a new species, *E. Ratzeli*, from the northern parts of Norway. Figures are given of the characteristic parts of the last two species.

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* See ante, p. 152.

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